

There was impaired resonance with prolonged expiration at the right apex. Diminished resonance, prolonged expiration, and moist crepitations over the greater part of the upper lobe and at the apex of the lower lobe on the left side. Tubercle bacilli were found in the sputum. She remained in the hospital (Hampstead and Northwood) until October, 1909, when she left much improved. She has not been at work since, but wrote at Christmas that she felt well and was anxious to get a situation as soon as possible.

*Apparent Infection during Residence in Hospital.*

Probationer Nurse Marie M., aged 25. Examined on entry, February, 1900, and found healthy. In November, 1900, she was reported to me, having got thinner and lost weight. She was easily tired, slept badly, and suffered from headaches.

I found the breath sounds harsh at the right apex, where there were some inconstant crepitant râles. A week later crepitations were detected at both apices, and she was put off duty. A month later the signs were more definite, especially at the right apex. She remained under my care for about five years before I could certify that the mischief was completely arrested. During this time she spent three and six months respectively at sanatoriums, the second occasion being in consequence of activity in the left lung, the right being quiescent.

For the last three years—July, 1902, to July, 1905—she was on night duty at the hospital. During the whole period she never had any expectoration. She has, since leaving the hospital, held posts at private sanatoriums, and remains well, reporting herself to me for examination at intervals when in London.

Nurse M. was engaged for some months before her breakdown in charge of the out-patient waiting room, and it seems possible that she became infected from the out-patients, who are not sufficiently careful in the matter of expectoration until they have been instructed in the necessary precautions. The out-patient department at Hampstead has since been closed.

Rose H., aged 21. Wardmaid. Entered the hospital in October, 1902, and was then quite healthy. In April, 1905, she was "run down," had some morning cough, and on examination was found to have harsh breathing and some moist crepitations in the apex of the right lung. Examination of the sputum showed the presence of tubercle bacilli.

She was taken off duty and put under treatment. She remained under treatment at Hampstead and Northwood until her death in 1908. It was found that this girl had become engaged to a patient who had tuberculous laryngitis, and who, when he left the hospital, took rooms at Hampstead. There were thus many opportunities of direct infection.

Jessie W., aged 26. Probationer nurse. Entered December, 1907. Healthy. In February, 1908, she ran a splinter into the left first finger whilst rubbing a ward table. A week later the finger was swollen and brawny, and Mr. Berry laid the track of the splinter open in the Royal Free Hospital, where the condition was pronounced to be tuberculous.

In October, 1908, the finger was practically well, but the nurse was very anaemic and not very strong. After a short time she improved considerably, and is now still on duty in the hospital.

Winifred E., aged 21. Probationer nurse. Entered March, 1905. She was anaemic, the weight was subnormal; she had a somewhat flattened chest but the lungs were healthy.

In the summer of 1906 she crushed one of her fingers in a door, and shortly after the finger showed signs of local suppuration. She went for a holiday to Switzerland, and soon after her return she was found to have lost 3 lb. in weight since her holiday; she was anaemic but there were no abnormal physical signs in the chest. In October, two months later, she complained of pain in the foot when walking. Mr. Berry examined the foot, which was slightly discoloured and swollen on the dorsum, and diagnosed tuberculosis of the metatarsal joint. She left the hospital a month later, and is now—October, 1909—perfectly healthy and well.

Lily M., aged 16. Housemaid. On entry in November, 1908, she was noted as tall and slight, with slight lateral curvature of the spine. The chest was healthy, except for a few creaking sounds on the left front. In January, 1909, she cut her hand with a knife. A few days later she broke some crockery, and thinks she got something into the wound of the previous cut. A week later there was swelling in the palm of the hand, which was tender on deep pressure. She was admitted into the Royal Free Hospital under Mr. Berry.

William C., aged 29. Engineer. Entered 1906. Was quite well until May, 1908, when he complained of pains in the chest and general weakness. On examination the only abnormal signs heard in the chest were a few rhonchi scattered throughout the lungs. He quickly improved, and felt well again, but about a month later he felt pain in the sternum and commenced to cough. No history of chest disease in the family. There was prolonged expiration at the right apex with a few crepitant râles. Rhonchi all over the back. At the left apex crepitations were heard both back and front. Tubercle bacilli were found in the sputa. A week later he had some pleurisy (dry) at the right base, and the physical signs at the right apex were more marked. By October 1st the chest was practically clear again, and he has since remained perfectly well. He is still on duty at the hospital.

REFERENCES.

<sup>1</sup> BRITISH MEDICAL JOURNAL, August 21st, 1909. <sup>2</sup> *Lancet*, i, 1884, p. 837. <sup>3</sup> BRITISH MEDICAL JOURNAL, September 20th, 1882.

## A Lecture

ON

## MENINGITIS IN CHILDREN.

DELIVERED AT THE LONDON SCHOOL OF CLINICAL  
MEDICINE.

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THERE are three varieties of meningitis to which children are specially liable—tuberculous; posterior-basic; and suppurative. Other forms of meningeal inflammation also occur, but, in comparison with these three, they are rare. It is still doubtful whether posterior-basic and cerebro-spinal meningitis should be differentiated from one another. The diplococcus which is found in the two disorders is apparently the same, the one being, in all probability, an attenuated variety of the other. The symptoms mainly differ in being comparatively mild in posterior-basic cases and in occurring principally in infants under one year of age; whereas in cerebro-spinal cases the manifestations are more acute, children are liable to its influence at all ages, it often occurs in epidemic form, and it is commonly associated with purpuric or other skin rashes.

### TUBERCULOUS MENINGITIS.

Tuberculous meningitis in most instances depends upon an extension from an old-standing focus, frequently in the bronchial or mesenteric glands, but sometimes from a tuberculous process in the middle ear. Though it may occur at any age, the large proportion of cases develop between the second and fifth years of life. Where there is no obvious pre-existing tuberculous disease elsewhere, the onset is often so insidious that a definite diagnosis within the first week or two may be impossible. During this time there may be nothing more remarkable about the child than an unwonted peevishness and irritability, with restlessness at night and capriciousness as to food. He may, even thus early, complain from time to time of headache, or may inarticulately manifest discomfort by uneasy movements of his head. He desires to be left alone, and refuses to be amused in the usual way. His bowels become confined, and every now and again, for no apparent reason, he vomits without retching or effort, and independently of a previous meal. The restlessness at night is soon accompanied by startings in which the child wakes himself screaming, and by grinding of the teeth; while during the day he begins to manifest an unnatural drowsiness, and to assume a decubitus which is suggestive; he lies on his side with his hips and knees flexed, his arms close to his sides and acutely bent at the elbows, and his fingers, in a semi-unconscious way, constantly picking his nose or lips. He becomes increasingly irritable, and resents any form of movement. His headache is now more constant, and seems to be paroxysmally increased by light, noise, or any form of disturbance. Under the influence of such an exacerbation of pain he often clasps his head with both hands, and emits a short, sharp scream, which is described as the hydrocephalic cry. He wanders a little at night, and the pyrexia, which was at first insignificant and intermittent, is now continuous and generally higher in the evening than the morning. The pulse, which was at the beginning somewhat accelerated, becomes irregular, of full tension, and sometimes remarkably slow. The tongue is furred, the breath offensive, the urine thick and concentrated, and the bowels still obstinately constipated. The pupils are usually contracted, and slight ptosis of one eyelid or some degree of strabismus may develop. The muscles at the back of the neck stiffen, but there is very rarely any marked retraction of the head such as occurs in posterior-basic cases. Tremors of the head and limbs on movement are often noticeable. The abdomen may assume the hollowed-out appearance known as the "boat-shaped belly," and the *tâche cérébrale* can readily be elicited on scratching the skin.

Gradually the irritative symptoms characteristic of the invasion period of the disease subside. The child is now completely apathetic; he no longer complains of headache

or resists actively the attentions of his nurse; the respiration becomes sighing, the pyrexia lessens, and the retraction of the abdomen increases. The pupils, instead of being contracted, are dilated and often unequal, and a moderate degree of optic neuritis is not uncommon. He rolls his head uneasily from side to side, often waves his arms about, and his face is subject to sudden flushes, which by-and-by become permanent. The physiognomy of this stage is thus graphically described by Trousseau:

He groans from time to time, opens his eyes wide, which shine as they do in persons who are drunk. His face, which is usually extremely pale, flushes for a second or two, then he closes his eyes again, and resumes his former aspect. Generally, as he thus opens his eyes, and as his face colours up, the child utters a plaintive cry, which is perfectly characteristic.

The stupor deepens and eventually terminates in coma, from which there is no rousing. Both pulse and respiration increase in rapidity; the former is irregular as well as rapid, and the latter is apt to assume the Cheyne-Stokes type of rhythm. Mucopus accumulates on the corneae and a typhoid state supervenes, in which there is a low muttering delirium, floccitatio, subsultus tendinum, and paralysis of the sphincters. The child now almost invariably assumes a dorsal decubitus, with his limbs extended and all his muscles flaccid. The temperature shoots up again and may reach 106° or 107°, the pulse becomes small and uncountable, the surface of the body cold and cyanotic, and not infrequently death is ushered in by one or more convulsions. It ought to be remembered that it is not unusual, even in an advanced stage of such an illness, for a delusive and temporary improvement to take place. The little patient may suddenly become more active mentally, and in other respects revive so remarkably as even to raise hopes of his recovery; but they are always doomed to disappointment, the apparent betterness being little more than the last flicker of the burned-out candle, which very soon becomes permanently extinguished.

Reckoning from the date of distinct establishment of the disease to the day of death, Gee estimated the usual duration of life at twenty-three days. This is approximately true in the majority of cases, but some die earlier, and many last much longer. Cases of recovery are so rare that many observers believe the disease to be invariably fatal, but Howship Dickinson, who gave the subject special attention, was of opinion that about 2 per cent. of all cases recover.

#### POSTERIOR-BASIC MENINGITIS.

This is the most common variety of non-tuberculous meningitis in children, and occurs, in the large majority of cases, within the first year of life. But though posterior-basic cases are the most frequent, a vertical type of non-tuberculous meningitis, which will be described under the suppurative variety of the disorder, is also met with in which the inflammation mainly affects the convexity of the brain. In cases of the posterior-basic type, the onset is characterized by headache, irritability, restlessness, and vomiting. The headache is intense and constant, but is subject to acute paroxysms which often elicit piercing cries. Screaming is, in some cases, almost continuous, and always increased in violence if the child is in any way disturbed. In infants, fullness of the unclosed fontanelle within the first few days of illness is fairly common. Retraction of the head is always a prominent and early symptom, and is due to tonic contraction of the posterior cervical muscles. This contraction sometimes extends to the muscles of the back, causing opisthotonos, or to the limbs, which may be either firmly flexed or extended. This tendency to muscular spasm is responsible for Kernig's sign, which is now recognized as such a valuable help to the diagnosis of all forms of meningeal affection. The sign consists in a difficulty or impossibility, when sitting up, to keep the leg and thigh in a straight line. If the patient is placed on his back in bed, the leg can be relaxed and fully extended at the knee, but whenever he is raised to the sitting posture, or the leg is flexed at the hip, so as to bring it at a right angle to the trunk, flexion takes place at the knee and cannot be overcome without the use of considerable force and without causing the patient to cry out. The temperature is more disturbed in vertical than in basic cases, but it is always irregular and is liable to become hyperpyretic before

death. The respiration is rapid, often accompanied by deep sighing, and eventually becomes rhythmically irregular, if not actually Cheyne-Stokes in character. The pulse is irregular and may be abnormally slow. The abdomen may retain its normal rotundity, but in many cases becomes retracted. *Tâche cérébrale* is, as a rule, well marked, while flushing and other evidences of vasomotor disturbance, though not so frequent as in tuberculous cases, are sometimes very pronounced. Emaciation is always a striking feature. The pupils are usually contracted and equal; strabismus is not unusual, and the eyes may remain imperfectly closed from retraction of the upper lid. Optic neuritis is rare, but, on the other hand, nystagmus is common. Champing or sucking movements of the lips, grinding of the teeth, and paroxysmal yawning are often prominent symptoms. The bowels are, in most instances, constipated—though never so persistently as in tuberculous cases—and the evacuations are dark and offensive. Exceptionally, diarrhoea occurs as a troublesome complication. As a rule, there is no eruption on the skin, but in a few cases a temporary erythema is noted. Convulsions may occur at any period of the illness, and are usually bilateral. The knee-jerks are always present and are often exaggerated. Various forms of paralyses may occur, their distribution being regulated by the situation and extent of the inflammation. Hemiplegia or monoplegia are, for obvious reasons, more frequent in vertical than in basic cases. The early restlessness and delirium are gradually replaced by stupor and coma; contraction of the pupils gives way to dilatation; and the sphincters become incompetent. Ultimately extreme prostration is revealed by livid and shrunken features; a rapid, thready, and irregular pulse; shallow breathing; cold, clammy perspirations; and not infrequently oedema of the lungs as a prelude to death. The vertical form of simple meningitis is mostly an acute process, but the basic variety is more chronic, and may last over several weeks. Recovery is not common, and when it occurs is often incomplete. Hydrocephalus is apt to be induced by adhesions closing up the foramina between the cerebral cavities and the subarachnoid space, and this may be responsible for mental and moral defects which remain as a permanent legacy from the illness. Though epidemic cerebro-spinal meningitis has much in common with simple meningitis, its detailed description does not come within the compass of to-day's consideration.

It happens, fortuitously, that I am able to show a case illustrative of this basic variety of meningitis. This child is 3 months old, and was admitted to the hospital, as an emergency, about a fortnight ago. A week before admission the child was unusually fretful, and the head gradually became retracted to the position in which you now see it, while at the same time the infant became first apathetic, then drowsy, and, finally, comatose. The family history is unimportant. The decubitus is such as I have tried to describe; the pupils are equal, and there is no squint; Kernig's sign is well marked; the anterior fontanelle is distinctly bulging; the knee-jerks are active, and the plantar response is extensor on both sides. The bowels are constipated, and there has been repeated vomiting. The abdomen is flat if not actually retracted. The *tâche cérébrale* is easily demonstrated. The temperature has been erratic, but not seriously disturbed; the respirations are rapid and irregular, and the pulse is also small, feeble, and quick. Lumbar puncture has yielded a turbid fluid, which has been found to contain a large number of polymorphonuclear leucocytes, and also diplococci in small but definite numbers. These have been cultivated, and prove to be the true meningococcus.

#### SUPPURATIVE MENINGITIS.

Suppurative meningitis may follow injuries to the head or be caused by extension of inflammation from neighbouring parts—the middle ear, the mastoid cells, the nasal cavities, etc. It occurs also as a complication in such acute general diseases as pyaemia, scarlet fever, small-pox, and sometimes pneumonia. The symptoms bear a general resemblance to those met with in tuberculous meningitis, but they are usually much more rapid in their development. When meningitis of this type supervenes upon acute disease elsewhere, the symptoms are often masked so completely by those of the primary affection that death may occur without a suspicion being aroused of meningeal implication. In cases secondary to chronic inflammatory lesions like otitis media the symptoms may set in acutely with rigor, headache, and vomiting. The child shuns light and noise, and lies curled up in bed, as

in the tuberculous variety. The neck muscles are stiff, and the head may be retracted, but never to such an extreme degree as is met with in posterior-basic cases. Convulsions often occur, early as well as late, and are associated with delirium and drowsiness. Various forms of paralysis corresponding to the situation of the inflammation are apt to declare themselves, and owing to the fact that the vertex is most frequently the seat of disturbance, the cranial nerves are more likely to escape, while those originating in the motor area of the brain are more liable to be involved. An arm, or leg, or the face alone, may be paralysed, or there may be complete hemiplegia or paraplegia. The pupils are contracted in the early, and dilated in the later, stages of the illness, and optic neuritis is of common occurrence. The temperature is high from the beginning; respiration is sighing and irregular; Kernig's sign is well marked; and, in many cases, the abdomen is retracted and hollow. The drowsiness deepens rapidly into coma, and within two or three days of the first development of symptoms the circulation fails and death ensues.

#### DIAGNOSIS.

The differential diagnosis of these three varieties of meningitis is not difficult, and rests mainly on the following points. In tuberculous cases the combination in the early stages of the disease of headache, vomiting, and constipation should always arouse suspicion. These symptoms may, it is true, be produced by such innocent causes as dentition, gastro-intestinal catarrh, or an ordinary bilious attack, or they may be due to the onset of one or other of the specific fevers, but it is always possible, with patience and time, to eliminate, one after another, these hypothetical explanations of the initial manifestations. Fullness and pulsation of the anterior fontanelle, though not conclusive, adds considerable strength to the initial suspicion. The optic discs should always be inspected, because, though pronounced changes in them are generally found only in the later stages of the disorder when the diagnosis is already assured, there are instances in which it occurs early, and throws a flood of light on the true nature of the other symptoms. As the illness develops the persistence of headache in the presence of delirium, the decubitus of the child, the avoidance of light, the resistance to movement or disturbance of any kind, the presence of Kernig's sign, the development of the characteristic hydrocephalic cry, the retraction of the abdomen, the character of the pulse, the occurrence of ocular palsies, and the tendency to a gradually deepening stupor, constitute the facts upon which it is possible to establish a firm diagnosis. The use of tuberculin, either by the application of Calmette's ophthalmic reaction or of von Pirquet's skin reaction, is valuable as an aid to early recognition of the true nature of the condition.

Posterior basic meningitis repeats many of the characteristics of the tuberculous variety, but it occurs as a rule at an earlier age, and is of more sudden onset. There is no prodromal period of malaise, and from almost the earliest beginning of the illness retraction of the head, together with flexor or extensor spasm of the limbs, is a marked and characteristic feature. The temperature is usually higher, and in some instances the occurrence of a blotchy erythema helps to clear up diagnostic difficulties. Progressive enlargement of the head in infants is distinctive of hydrocephalus, and occurs in basic cases from occlusion of the drainage channels of the cerebral ventricles.

Suppurative meningitis is a more acute process than either of the others. An unexpected convulsion in the course of an infective disease or of some localized inflammation in one of the cranial cavities is sometimes the first indication of meningeal complication. The supervention of headache, increased pyrexia, delirium, hemiplegia or monoplegia, muscular rigidity, Kernig's sign, optic neuritis, recurrent convulsions, and coma, all within three or four days, completes a clinical picture which is unmistakable.

In all cases of meningitis, lumbar puncture gives us information which may be valuable. It is only useful when taken in conjunction with the clinical symptoms, but it often serves to clinch a doubtful diagnosis as between one variety of meningitis and another. The

needle may be most conveniently introduced into the spinal canal between the laminae of the third and fourth lumbar vertebrae. If it is found that the tension of the cerebro-spinal fluid is increased, the inference is that there is probably some organic disease of the brain. An excess of cells points to inflammatory mischief, and a predominance of cells of the polymorphonuclear variety is indicative of an acute inflammatory process. Bacteriological examination will serve to determine the particular micro-organism upon which the inflammation depends.

The prognosis is grave in all three forms of meningitis; most so in the suppurative variety, slightly less in tuberculous cases, and least of all in those which belong to the posterior-basic type.

#### TREATMENT.

Time will not permit of any detailed reference to pathology or treatment, but in regard to the latter I wish to mention two posterior-basic cases which have recently been under my care at the Waterloo Hospital, and which have achieved a remarkable recovery. I am aware that in a certain proportion of this class of case recovery takes place under the usual methods of general treatment. I further admit that no reliable conclusions can be deduced from the experience of two fortunate results, but in both these children the illness seemed so desperate and the response to ordinary treatment by drugs and other general methods so disappointing that the improvement under the influence of injections of antimeningococcal serum may be worthy of consideration as a suggestion for the management of similar cases.

The history of these two children, who are here to-day for your inspection, and who are now both perfectly well, is, very shortly, as follows:

Elsie Ward was 5 months old when she was admitted to Waterloo Hospital in June last. She came with a history of vomiting of seven days' duration and the most striking objective feature about the child, on her admission, was extreme retraction of the head. Her pulse numbered 120, the temperature registered 102°, and her respirations were 35. She was abnormally drowsy; Kernig's sign was well-marked, and she had a double internal strabismus. Lumbar puncture was performed on the evening of the day of her admission and the fluid withdrawn was turbid and was found to contain large numbers of polymorphonuclear cells. These cells were crammed with diplococci, as many as fifteen being counted in one cell. The following morning the temperature was 104.5°, but after tepid sponging it fell to 102°; 25 c.cm. of antimeningococcal serum were administered hypodermically. A week later the general condition was distinctly improved. The temperature had fallen, the vomiting was occasional only, and the head retraction was diminished. Another lumbar puncture was done and the diplococci, though still present, were found to be much less numerous. Another injection of 25 c.cm. antimeningococcal serum was administered, and the improvement was maintained for the following five days. Vomiting, pyrexia, and drowsiness then recurred, and were so pronounced that for a fortnight the child was kept going by nutrient enemata and saline injections. A haemorrhagic rash also now appeared on the abdomen. A third injection of antimeningococcal serum was given, and from this time improvement was uninterrupted until the patient was discharged, apparently cured, at the end of July. I now show you the child, who is the picture of health and has been perfectly well since she left the hospital, and I ask you to confirm the foregoing history by hearing from the mother her account of the child's condition when she brought her to Waterloo Hospital at the end of June.

The other child, George Glass, is 5 years of age, and was admitted to the hospital on November 11th, 1909. A few days before admission his mother observed that he was unusually drowsy, and that at times he seemed to become unconscious. He had vomited on several occasions, his bowels were obstinately confined, he screamed loudly when interfered with, and refused all kinds of food. On admission he was apathetic and irritable, was able to answer questions, but took no intelligent notice of his surroundings, and when put to bed assumed a curled-up position on his right side. His head was retracted acutely; Kernig's sign was present; and he had distinct nystagmus. His abdomen was slightly concave, and, though there was no paralysis, the arms—and especially the left one—were notably tremulous on movement. The knee-jerks were active, the left more so than the right. The abdominal and thoracic organs were healthy. The temperature was 102° F., pulse 116, and respirations 35. For four days he was treated with febrifuges, purgatives, ice to the scalp, etc., in the usual way, but the temperature remained high, the screaming attacks continued, the head retraction increased, and altogether the child was obviously getting worse rather than better. Lumbar puncture was now resorted to, and the spinal fluid, which was turbid on withdrawal, was found to contain on centrifugalization a large number of cells, of which 98 per cent. were calculated to be of the polymorphonuclear variety. A small but definite number of diplococci were present within the

polymorphonuclear cells. No tubercle bacilli were to be found. On November 20th, there being still no improvement, 10 c.cm. antimeningococcal serum were injected hypodermically, the dose being repeated on November 23rd, 26th, and 27th, and on December 1st respectively. No definite improvement was apparent until after the last injection, when the temperature began to fall rapidly, consciousness returned, and all the serious symptoms abated. This satisfactory condition of things continued for five days, and then a relapse occurred, lasting for a further period of five days, during which the old symptoms were revived, though less acutely, with the temperature again shooting up to 103° F. It was then decided to inject 10 c.cm. antimeningococcal serum into the spinal canal, but an unexpected amelioration in the child's condition prevented this intention being carried into effect. From this time on recovery was uninterrupted, and here you see the boy apparently as well and healthy as he ever was. On January 5th another lumbar puncture for confirmatory purposes was done. The spinal fluid was then found to issue under a much diminished pressure; when centrifugized the deposit contained a few blood discs but no excess of leucocytes and no micro-organisms, and media inoculated with the deposit revealed no growth of the *Diplococcus intracellularis*.

I show you here the small flasks of antimeningococcal serum as they are sent out from the laboratory ready for use. Each flask contains 10 c.cm. We propose to inoculate the child we have examined this afternoon, in the first place hypodermically, and later on, if need be, by the intraspinal method.

It may be mentioned that in cases of tuberculous meningitis the fluid withdrawn by lumbar puncture, though turbid, is often sterile, but on centrifugalization tubercle bacilli can generally be demonstrated in the residue. The prevailing lymphocytes are of the small mononuclear type.

In suppurative cases the polymorphonuclear cells are in abundance, and the finding of the streptococcus, staphylococcus, pneumococcus, or other micro-organism in the centrifugalized residue affords confirmatory evidence of the type of meningitis which is under observation.

## AN IMMUNIZING SUBINFECTION IN SCARLATINA.\*

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THE continued investigation of scarlatina has given us proof abundant that the predominant factor in the spread of the infection is direct contact with persons suffering from the fever. It is true that some outbreaks of the disease are traceable to infection-bearing milk, and also that a certain number of cases may be due to infection from clothing—things as distinct from persons; but the predominant factor is usually recognized to be personal contact.

The more extensive supervision of contact cases and the routine examination of school classes in which scarlet fever has occurred have strengthened this belief, for they have resulted in the wider discovery in the affected classes of children who were passing through attacks of scarlatina so mild that they had been missed alike by parents and teachers, but who were acting as a continued source of infection to others.

### Missed Cases.

These cases are "missed" because the parent or teacher did not see the rash on the child; the sore throat was so slight that the child was well in a day or so, and no medical man was called in; or a medical man may have been called in, and either because the rash was very faint or absent, or because the rash had faded, a correct diagnosis was not made. The attack is a mild one; the child returns to school, and, especially if there is any ear or nose discharge, acts as a means of spreading infection; in about ten days the child is found to be peeling. I would emphasize the importance in class outbreaks of a full inquiry and examination of all children who have been absent from school on account of sore throat. Whether or not peeling is a source of infection is doubtful, the evidence is apparently in the negative; but it at least gives information as to the source of infection in a fresh case which may have puzzled the investigator.

Mention has been made of the evanescent rash with very slight symptoms, and of scarlatina *sine eruptione*. The

existence of the latter has been regarded as doubtful, its reputed occurrence having been ascribed to the fact that the rash, being slight and evanescent, had been missed.

### The Lower Grades of Infection.

But because scarlet fever infection varies so greatly in its characteristics as to produce all grades of rash, from the brilliant and vivid eruptions, hæmorrhagic and accompanied by miliary vesicles, to a slight erythema of low punctiform character which is hardly visible, it is not illogical to expect that the rash-producing properties of the infection may be traced to vanishing point.

In examining large numbers of children who were school class contacts of true cases of scarlet fever, I have found on not a few occasions that some of these children had no sign or symptom of scarlet fever except a condition of the tongue in which the papillae are well marked, with possibly a slight injection of the throat. In some of these children the surface of the tongue was furred, giving the "white strawberry" appearance; in others the "red strawberry" appearance was present. It has been my custom in dealing with school classes affected by scarlet fever to exclude any child who had a sore throat or any skin condition which might indicate the early stage of a scarlet fever rash, as well as any child who had ear or nose discharge. The children who showed this tongue condition were not excluded; they were watched, and in no case was I able to detect any other sign or symptom which would verify the diagnosis of an attack of scarlet fever. In tracing other cases of scarlet fever which subsequently occurred in such a class, I found that occasionally the tongue cases were possible, but rarely probable, sources of the infection of the fresh case.

### The Scarlatina Tongue.

The strawberry tongue of scarlet fever is due to the following sequence of events: First, a thick white fur accumulates on the tongue, due to an excessive proliferation of epithelium; then this fur begins to exfoliate, the fungiform papillae showing through as prominent congested points, giving the appearance of the white strawberry tongue. By the fourth day the fur has exfoliated, the papillae are very prominent and congested, and the appearance of the red strawberry tongue so typical of scarlet fever is produced. The white strawberry tongue is by no means diagnostic of scarlet fever. It occurs also in conditions such as measles and diphtheria; but the red strawberry tongue is said to be pathognomonic.

### An Immunizing Subinfection.

Many of the contact-children to whom I have referred had the red strawberry tongue, but showed no other sign of scarlet fever at the time; and in none of the cases which were kept under observation was there any subsequent sign to verify the diagnosis of scarlet fever in any of its stages. But all these children had been in contact with scarlet fever cases; and of the other children in the class who had also been in contact with these cases, but who did not show this tongue sign, some developed scarlet fever. It is not unreasonable, therefore, to suppose that these children who had the tongue sign may have had scarlet fever in so low a degree of infection that whilst it was too attenuated to produce any visible effect upon the more opaque and resistant epithelium of the skin, it was concentrated enough to produce an effect on the more delicate epithelium of the tongue; and, further, that the attenuated infection by which they had been attacked had immunized them against the more marked disease.

Another fact which appears to indicate the frequent existence of a scarlatinal infection of very low virulence is the occurrence in every outbreak of scarlet fever of sore throats among contacts who do not actually develop scarlet fever. The prevalence of these sore throats is, I believe, greater at the beginning of an outbreak of scarlet fever. My records are not complete enough for proof, but it is recognized that the autumnal outbreaks of sore throat are coincident with the onset, but not markedly continuous with the progress, of the autumnal rise in scarlatinal infection. This would support the belief that a high percentage of persons in contact with scarlet fever are infected, but many have so slight an infection that it causes no sign but sore throat and may immunize the individual from the greater infection. The infection of

\* Read to the Bournemouth Medical Society.